

INFLUENCE OF PHENOL COMPOUND ON SOME BIOLOGICAL ASPECTS OF THE THREE COTTON BOLLWORM SPECIES UNDER CONSTANT TEMPERATURE

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ABSTRACT

The experiments were conducted in Plant Protection Research Institute, Sharkia branch, Agriculture Research Center to study the toxic and biological effects of phenol compound against the pink, spiny and American bollworms under controlled conditions of (26 ± 1 C° and 70 ± 5 % R. H.). Data revealed that phenol compound had highly toxic effect on the eggs of the spiny followed by pink then American bollworms, but the highest toxic effect against newly hatched larvae attained against the American followed by pink then spiny bollworms larvae. On the other hand, the latent effects of the phenol compound on the three insect species were presented in increasing the accumulated mortality of larval and pupal mortality percentages, non significant increasing on larval duration of the three cotton bollworms insects, and significantly decreased in larval and pupal weight, increasing pre and post-oviposition periods, decreasing oviposition periods, male and female longevities and also reduced fecundity, while the highest reduction in laid eggs recorded on pink followed by American then spiny bollworms compared with untreated control, while the hatchability percentages decreased significantly with pink bollworm and non significant with spiny and American bollworms compared with untreated control.

INTRODUCTION

Cotton plants is one of the most important economical crops in Egypt and all over the world. The pink bollworm, [*Pectinophora gossypiella* (Saund.) (PBW), the spiny bollworm, *Earias insulana* (Boisd.) (SBW) and the American bollworm, *Helicoverpa armigera* (Hüb.) (ABW). Addition of phenolic to the *Heliothis zea* (Boddie) diet increased larval mortality and time required for the larvae to reach pupation and reduced rate of larval development. Pupal weight was reduced, but to a lesser extent than time to pupation (Daniel, 1990). Effect of some phenolic acids on growth and survival of cotton bollworm also showed extreme retardation of larval weight (Preveen, *et al.* 2001). Seasonal dynamics of total phenolics contents was highest in young branches, (146.17) to (169.23) mg/g, and decreased with maturity of *Casuarina equisetifolia* plant (Li-hua ZHANG, *et al.* 2009). Both leaf and bark extracts of *Casuarina equisetifolia* were toxic effect on the pink and spiny bollworms (Zaki, 2012).

The aim of the present studies were to evaluate the toxic and latent effects of phenol compound against the pink, spiny and American bollworms infested cotton crop in Egypt.

MATERIALS AND METHODS

1-Chemical used: Phenol 99% a commercial formulation from El-Nasr pharmaceutical chemicals Co. Egypt.

2-Rearing technique:

The proper conditions and diet for maintaining a mass culture of *P. gossypiella*, *E. insulana* and *H. armigera* were followed according to the method described by Abd El-Hafez *et al.* (1982). The artificial diet was changed after 7 days of treatment in the case of spiny and American bollworms with fresh one (Amer *et al.*, 2010).

The larvae were incubated at constant conditions of 26 ± 1 °C. and $70 \pm 5\%$ R.H. in an electrical incubation in bollworms laboratory, Plant Protection Research Institute (Sharkia Branch) at Zagazig, Sharkia, Egypt.

3-The methods of procedure:

3-1-Toxicity tests:

Three grams of phenol compound were dissolved in 30 ml ethyl alcohol 95% then it was added to 30 ml of water and put in a dark bottle color as stock solution. Four concentrations were prepared as (50000, 25000, 12500 and 6250 ppm) and replicated four times as well as untreated check. The tested concentrations diluted using water.

3-1-1-Ovicidal action:

One day old eggs (200 eggs) of PBW, SBW and ABW for each treatment as well as control treatment of each insect. The egg cards were dipped in the tested concentrations previous condition up to five sec., then the cards were left under laboratory condition to complete dryness. Hatching and un-hatching eggs of the pink, spiny and American bollworms were calculated and recorded until ten days from treatment. The LC_{50} and LC_{90} values were determined according to Finney method (1952).

3-1-2-Toxicity effect on larvae:

Five grams of artificial diet were put on a Petri-dish (7.50 X 2.00 cm). One ml of the tested concentrations or one ml of ethyl alcohol as control were added to the surface of the diet, and then left until dryness. Twenty five newly hatched larvae of PBW, SBW and ABW were transferred to treated artificial diet then left to feed. The alive and dead larvae of three insects were recorded after 48 hrs. Each treatment and control were replicated four times. The LC_{50} and LC_{90} values were determined according to Finney methods (1952).

3-2- latent effect on larvae:

To study the latent effect of Phenol compound on the three insects, the alive larvae in (12500 and 6250 ppm) concentrations of phenol compound and check were transferred individually to untreated artificial diet in glass tubes (2 X 7.5 cm) and incubated under the previous condition. The tubes were inspected daily until pupation to record larval & pupal duration, larval & pupal weight and larval & pupal mortality. The pupae were separated on Glass Jar (half kg.) until moth's emergence. The newly emerged moths were sexed and put in Glass Jar (half kg.). Each jar contains two pairs of insects of moths and replicated four times for each treatment and control. The moths

fed on 10% sugar solution. Pre-oviposition, oviposition and post oviposition periods, male and female longevity, number of deposited eggs and hatchability percentage were recorded.

4-Statistical analysis:

The obtained results of biological parameters were subjected to analysis of variance between all treatments using CoStat computer program Cohort Software. P. O. Box 1149, Berkeley CA 9471 (CoStat program methods 2005).

RESULTS AND DISCUSSIONS

Toxicology test:

Eggs:

Data in Table (1) showed the LC₅₀ and LC₉₀ values of phenol compound against PBW, SBW and ABW. The LC₅₀ and LC₉₀ of phenol compound against one day old eggs were 27116.4 and 153945.9 ppm for PBW, and for spiny bollworm were 6423.6 and 150548.2, while it were 33228.6 and 385370.9 ppm for ABW. The slope values were 0.94, 1.20 and 1.69 for SBW, ABW and PBW respectively.

Larvae:

Results in Table (1) indicated that the LC₅₀ and LC₉₀ values were 103006.7 and 2149952.7 ppm for newly hatched larvae of SBW, while it were 65919.9 and 997214.5 ppm for PBW after 48hrs from treatment, Meanwhile, the LC₅₀ and LC₉₀ values were 31671.2 and 260373.0 ppm for ABW. The slope value was decreased after ten days (0.97) for SBW, while it was (1.09) for PBW. On the other hand, the slope value was (1.40) for ABW. Data obtained showed that the newly hatched larvae of American bollworm was the highest susceptible for phenol compound than other insects.

Table (1): Toxicity of phenol compound against larvae and eggs of the *P. gossypiella*, *E. insulana*, and *H. armigera*

Insect	Insect stage	LC ₅₀	LC ₉₀	Slope
<i>P. gossypiella</i>	Larvae	65919.9	997214.5	1.09
	Eggs	27116.4	153945.9	1.69
<i>E. insulana</i>	Larvae	103006.7	2149952.7	0.97
	Eggs	6423.6	150548.2	0.94
<i>H. armigera</i>	Larvae	31671.2	260373.0	1.40
	Eggs	33228.6	385370.9	1.20

1-4-Effect of phenol compound on some biological aspects of the pink, spiny and American bollworms:

Larval duration:

Statistical analysis of data in Table (2) indicated that non significantly differences were found between larval duration of the three insects and control.

Larval weight:

Data presented in Table (2) generally indicated that phenol compound caused significant decreasing in larval weight as compared with that of untreated check for the three insects tested.

Larval mortality percentage:

Results shown in Table (2) revealed that the larval mortality percentages of PBW, SBW and ABW increased significantly than untreated larvae. The highest average percentage of larval mortality recorded 60.00 % with ABW at (12500 ppm) compared with 5.00% with control, while, the lowest mortality percentage was 20.00 % with SBW at (6250 ppm) compared with 4.00% with control.

Table (2): Effect of treated newly hatched larvae of the *P. gossypiella*, *E. insulana*, and *H. armigera* with phenol compound on the immature stages.

Insects	Conc. ppm	Larval duration	Larval weight	Larval mortality	Pupal duration	Pupal weight	Pupal mortality
<i>P. gossypiella</i>	12500	14.50	0.0254b	45.00a	10.75a	0.0230	20.00a
	6250	14.00	0.0270b	25.00b	10.25a	0.0240	15.00b
	Control	13.50	0.0380a	5.00c	9.50b	0.0245	0.00c
	F.test	N.S	**	**	*	N.S.	**
	LSD _{0.05}	-	0.0030	6.317	0.739	-	2.579
<i>E. insulana</i>	12500	16.25	0.0650c	40.00a	10.75a	0.0520b	30.00a
	6250	16.00	0.0710b	20.00b	10.25b	0.0570a	25.00a
	Control	15.25	0.0830a	4.00c	10.25b	0.060a	5.00b
	F.test	N.S.	**	**	*	*	**
	LSD _{0.05}	-	0.0040	6.318	0.479	0.005	6.318
<i>H. armigera</i>	12500	17.00	0.365c	60.00a	16.50a	0.328b	15.00a
	6250	16.50	0.405b	45.00b	16.00ab	0.397a	11.00b
	Control	15.50	0.470a	5.00c	15.00c	0.423a	5.00c
	F.test	N.S.	**	**	*	**	**
	LSD _{0.05}	-	0.0245	7.476	1.301	0.0356	1.998

Pupal duration:

Analysis of variance of the results in Table (2) showed that all concentrations led to significant prolongation in pupal duration compared with the control in each the three tested insects, except that resulted from the lowest concentration of phenol with SBW where the pupal developed was similar with control in duration.

Pupal weight:

Data presented in Table (2) showed that phenol caused decreased in pupal weight, but only the highest concentration of phenol compound caused significant decreased in pupal weight of SBW and ABW, as compared with control.

Pupal mortality percentage:

Statistical analysis of the data in Table (2) indicated that phenol compound caused significant increasing in pupal mortality percentages of the pink, spiny and American bollworms compared with control. The highest pupal mortality recorded 30.00 % with SBW at (12500 ppm) as compared

with 0.00 % in control, while the lowest one was 11.00 % with ABW at 6250 ppm as compared with 5.00 % in control.

Pre – oviposition period:

Data represented in Table (3) proved that the two tested concentrations of phenol compound have significant effect on pre-oviposition periods of the pink but in case of the American and spiny bollworm it were non significant as compared with control.

Oviposition period:

The data presented in Table (3) it can be observed that the two tested concentrations of phenol compound caused significant decrease in the oviposition period of the pink and spiny bollworms, while with American bollworm it had highly significant decrease as compared with the untreated one.

Table (3): Effect of treated newly hatched larvae of the *P. gossypiella*, *E. insulana* and *H. armigera* with phenol compound on the mature stages.

Insects	Conc. ppm	Oviposition periods(days)			Adult longevity (days)		Fecundity	Hatchability %
		Pre	Ovi	Post	Female	Male		
<i>P. gossypiella</i>	12500	7.00a	3.50c	4.50	15.00	17.00	95.00c	85.00b
	6250	6.50a	5.50b	4.00	16.00	19.00	130.00b	90.00ab
	Control	3.00b	12.00a	3.50	18.50	20.00	210.00a	96.00a
	F.test	*	**	N.S.	N.S.	N.S.	**	*
	LSD _{0.05}	2.374	1.913	-	-	-	16.913	8.238
<i>E. insulana</i>	12500	6.00	6.00b	5.25	17.25	13.00	70.00b	87.00
	6250	5.50	7.00b	5.00	17.50	13.50	80.00b	91.00
	Control	5.00	8.00a	4.75	17.75	14.50	107.00a	95.00
	F.test	N.S.	*	N.S.	N.S.	N.S.	**	N.S.
	LSD _{0.05}	-	1.73	-	-	-	14.82	-
<i>H. armigera</i>	12500	3.50	2.50c	3.00a	9.00c	8.00b	262.00c	60.00
	6250	3.00	4.50b	2.50ab	10.00b	9.00ab	317.00b	65.00
	Control	2.50	6.67a	2.00b	11.17a	10.00a	490.00a	70.00
	F.test	N.S.	**	*	**	*	**	N.S.
	LSD _{0.05}	-	1.59	0.99	0.88	1.49	53.16	-

Post oviposition period:

Analysis of variance in Table (3) showed that the two tested concentrations of phenol compound exhibited increasing in the post-oviposition periods, which was significant in the case of the American bollworm compared with control, while was non significant with PBW and SBW as compared with control.

Adult longevity:

Statistical analysis of the data in Table (3) cleared that the tested concentrations of phenol compound decreased the adult longevity for both male and female moths, which was non significant with the pink and spiny bollworms, while in case of American bollworm significant decreasing was exhibited of male and female longevity comparing with that of check treatment.

Number of deposited eggs / female:

As shown in Table (3) all the tested concentrations of phenol compound caused highly significant reduction in eggs laid by the pink, spiny and ABW

bollworms females as compared with control. The lowest deposited eggs laid was 95.00 eggs/ female with PBW at 12500 ppm, compared with 210.00 eggs/ female in control check, but in case of SBW the eggs laid was 70.00 eggs/ female compared with 107.00 eggs/ female in untreated, while the lowest eggs laid was 262.00 eggs/ female with ABW as compared with 490.00 eggs/ female on untreated.

Hatchability of eggs:

Data in Table (3) showed that the two tested concentrations of phenol compound exhibited **significant reduction in hatchability percentage** of the pink bollworm and non significant with SBW and ABW as compared with control.

This result are agree with (Daniel, 1990) indicated that addition of phenolic to the *Heliothis zea* (Boddie) diet increased larval mortality and time required for the larvae to reach pupation and reduced rate of larval development. Pupal weight was reduced, but to a lesser extent than time to pupation. (Preveen, *et al.* 2001) stated that the effect of some phenolic acids on growth and survival of cotton bollworm also showed extreme retardation of larval weight.

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تأثير مركب الفينول على المقاييس البيولوجية لثلاثة أنواع ديدان اللوز تحت درجة حرارة ثابتة

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أجريت تجارب بمعهد بحوث وقاية النباتات، فرع الشرقية، مركز البحوث الزراعية لدراسة التأثير السمي والبيولوجي لمركب الفينول على ديدان اللوز القرنفلية و الشوكية والأمريكية تحت ظروف حراره ورطوبة ثابتة (26 ± 1 درجة مئوية و $70 \pm 5\%$ رطوبة نسبية). النتائج أظهرت أن مركب الفينول له تأثير سمي عالي على بيض دودة اللوز الشوكية يليها القرنفلية ثم الأمريكية. وبالنسبة للفقس الحديث كان التأثير أقوى على الأمريكية ثم القرنفلية يليها الشوكية . من جهة أخرى فإن التأثير المتأخر لمركب الفينول على الثلاثة حشرات كان يتمثل فى زيادة الموت التراكمى لليرقات وكذلك نسبة موت العذارى ، وكان هناك زياده غير معنوية لعمر اليرقات بالنسبة لديدان اللوز الثلاثة ، كما كان هناك إنخفاض معنوى فى وزن اليرقات والعذارى كما كان هناك زياده فى فترة قبل وبعد وضع البيض ونقص فى فترة وضع البيض وكذلك نقص فى طول عمر الحشرات الكامله ذكور وإناث كما حدث خفض فى الخصوبة حيث كان اعلى نقص فى كمية البيض الموضوع سجل مع دودة اللوز القرنفلية يليها الامريكية ثم الشوكية بالمقارنة بالبيض الموضوع فى الغير معاملة ، أما بالنسبة لنسبة الفقس فإنها إنخفضت معنويا فى حالة دودة اللوز القرنفلية وإنخفاض غير معنوى مع الشوكية والأمريكية مقارنة بالغير معاملة.

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